Petroleum University of Technology

# In the name of GOD

# Linear vibration forced viscous damper

Report from a laboratory experiment conducted on?? 17-may-17

As part of vibration lab

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## Abstract:

Reviews impact damper and the frequency of the excitation force of amplitude and phase.

Gain and phase response curves against the frequency ratio.

Compare the experimental curves with a degree of freedom system frequency response theory.

## Table of Contents

# 1. Introduction and Background

As you know, vibration equation of a dynamical system consisting of the mass, spring and damper
Figure 1-1 is as follows:
Mx + cx + kx = F (t)
General solution (vibration): Public solve the above equation (Equation call homogeneous without input) is as follows: Where A and B are constants determined from initial conditions.
The roots of the characteristic equation are equal to the following values:

# 2. Theory

$$s_{1,2} = -\frac{c}{2m} \pm \sqrt{\left(\frac{c}{2m}\right)^2 - \frac{k}{m}}$$

The definition of natural frequency and critical damping as follows:

$$\omega_n = \sqrt{\frac{k}{m}}$$

$$c_c = 2\sqrt{km} = 2m\omega_n$$

As well as a dimensionless number defined as damping ratio (the ratio of actual damping damping system
Critical):

$$\xi = \frac{c}{c_c}$$

# 3. List of Equipment Used

The differential equation and the roots of the characteristic equation, terms and
Expressed:

$$\ddot{x} + 2\xi\omega_n\dot{x} + \omega_n{}^2 x = \frac{1}{m}F(t)$$

$$s_{1,2} = (-\xi \pm \sqrt{\xi^2 - 1})\omega_n$$

# 4. Procedure

1 - Get tough spring, a weight of 800 grams and add to the junction of the bar springs

The static deflection of the beam read.
2 - Obtain the natural frequency of the system, the system Remove Mercury from
And drop off balance. Measure and record time of 10 swings.
3 Quantity mass and radius of the measure misalignment.
4 - To pass, while oil closed pores within 2.0 meters of the Lula install.
Prepare a paper record vibrations on the device. Meanwhile, place the disc on the screen holes
Registration phase difference however you like.
5 - To get back to the low-speed ratio and engine speed by counting the number of times the disc
Get in 30 seconds.
6 - Engine to deliver values in Table 1 and using the recorded vibrations, scope and
After reaching the stationary conditions of phase vibrations measure.
Private solutions (forced vibrations): By applying a force to the harmonic spring-mass system
7 Part 6 identically to pass through the pores, where the oil damper is open and the non-amortized
Repeated here. (Tables 2 and 3. (
8 dimensions needed to complete the tests measure here.

And damper Figure 1-1 in the equation of motion is as follows:

$$m\ddot{x}+c\dot{x}+kx=F_0\sin\omega t$$

$$\ddot{x}+2\xi\omega_n\dot{x}+\omega_n{}^2x=\frac{1}{m}F_0\sin\omega t$$

F0 is the maximum force. Private solve the equation
Where □ input frequency (or frequency stimulation)
Above or amplitude of the vibrations of the system forced (after amortization of transient response) is as follows:

## 5. Data

$$x(t)=X\sin(\omega t+\varphi)$$

Where X is the maximum amplitude and the phase difference between the call and input □ obtained from the following formula:

$$X = \frac{F_0}{m\omega_n^2 \sqrt{\left(1-(\frac{\omega}{\omega_n})^2\right)^2 + \left(2\xi\frac{\omega}{\omega_n}\right)^2}}$$

$$\phi = tg^{-1}\left(\frac{2\xi\frac{\omega}{\omega_n}}{1-\left(\frac{\omega}{\omega_n}\right)^2}\right)$$

## 6. Discussion of Results

By defining the scope of force as a relationship without fluctuation range is obtained for the following:

$$\frac{mX}{Mr} = \frac{(\omega/\omega_n)^2}{\sqrt{\left(1-(\frac{\omega}{\omega_n})^2\right)^2 + \left(2\xi\frac{\omega}{\omega_n}\right)^2}}$$

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## 7. Conclusions

The apparatus is the same universal frame includes the following sections:
1 -Tyr rigid at one end by a hinge joint and the other end connected to the frame by spring Helix with flexibility coefficient k is connected to the upper part.
2 - By a factor of c, which can be installed in different parts of the beam resulting in a loss factor The system can be changed by it. The c
oefficient of damper by opening and closing
For in it is adjustable valves.

3 - The electric motor is mounted on the beam and discs sideways into the era now. This Disks are asymmetric because of a hole in one side and thereby turning on the engine, a driving force in the direction perpendicular to the beam harmonic is created.

4 -Device recorded vibrations by a layer of paper and synchronous motors with constant speed Moved and installed by the AA at the free end of July, the vibration is recorded.
5 -Device registration phase difference as follows:
Stereoscope external device key to put the device in front of the screen labelled
We take. Each circuit connecting a flash stereoscope (frequency driving force) is struck

Shining it on the screen with circular, the phase shift can be

## 8. References

Book
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=12&ved=0ahUKEwiCific2qjUAhXIcRQKHeLNB9oQFghoMAs&url=http%3A%2F%2Fsv.20file.org%2Fup1%2F541_0.pdf&usg=AFQjCNGNphLg_X55M7i7uf6b7SV363Fyqg&sig2=IvZ4WopWguWTarKktUsNvg
http://www.brown.edu/Departments/Engineering/Courses/En4/Notes/vibrations_forced/vibrations_forced.htm